Consumer Demand for Carbohydrates: A Look Across Products and Income Classes

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Introduction

A number of studies have used Nationwide Food Consumption Survey (NFCS) data and similar types of cross-sectional data sets to estimate demand and expenditure elasticities for food products (Park, et al., 1996; Huang, 1985 and 1996; Gao, et al., 1994; Blanciforti and Green, 1983a, 1983b). These studies have generally addressed very broad food groups and most of the empirical findings have revealed statistically significant own- and cross-price elasticities. Further, inelastic own-price and positive cross-price elasticities have been reported for most food groups, suggesting substitute relationships among these foods. In a study specific to carbohydrates and most relevant for this research, Gao, et al. (1994) used NFCS data and estimated a complete demand system for selected carbohydrates. Results from their study show all own-price elasticities to be inelastic and all cross-price elasticities to be positive with statistically significant substitute relationships.

Despite the propensity of NFCS data to yield parameter estimates which appear meaningful from both a theoretical and empirical viewpoint, many researchers and statisticians have questioned the validity of results derived from such data sets (U.S. General Accounting Office (GAO), 1991). Two of the more troubling questions statisticians have raised about NFCS data

are: (1) is it rich enough to reflect the diversity of the U.S. population?; and (2) is it of sufficient quality to warrant use for decision-making, especially policy-making? A panel of experts have answered no to both questions, but given the extensive use researchers continue to make of NFCS data, it seems reasonable to derive results from other data sets and then compare and contrast these results with those derived from NFCS data. Indeed the GAO report specifically recommends such comparisons (p. 48). To this end, the objective of this study is to use supermarket scanner data to estimate own-, cross- and expenditure elasticities for several carbohydrates -- dried, fresh and frozen potatoes, pasta, and rice. These elasticities will then be compared with those derived in studies using NFCS data.

Because of the limited geographic scope of the data used in this study, it is unlikely that the derived elasticities will serve as definitive measures of these parameters at the national level. However, given the closer theoretical linkage of elasticity parameters with time-series data than with cross-sectional data, it is hypothesized that elasticities derived here will more closely approximate "true" measures of elasticities. Further, since the data used will be segmented by income groups, the derived elasticities are expected to shed insight on the differential response behavior of lower- and higher-income consumers. Additionally, the more detailed data set of this study is likely to reveal relationships that may have been

previously compromised by extensive data aggregation.

Some Limiting Characteristics of NFCS Data

Use of NFCS data for empirical analyses has generally required researchers to aggregate products into very basic food groups. For example, all brands and types of pasta simply become pasta, and all brands and types of potatoes simply become potatoes. More meaningful units of analysis, such as package sizes, brand names and other quality attributes, have not been used because these details either have not been available or they have been available in formats that require cumbersome disaggregation. Such limitations, however, have impeded the specification of theoretically plausible and empirically meaningful one-to-one relationships between consumer purchases and consumption decisions. Economic theory would suggest that consumer purchases do not result from deliberate efforts to evaluate the average or minimum price per ounce or pound for a product, but rather from realistic evaluations of the choices consumers confront (brands, sizes, quality dimensions, etc.).

Particularly important to the purchase decisions of most consumers are the absolute and relative prices faced at the point of purchase (Varian, 1993). Yet, NFCS data and similar types of data allow for just an approximation of these prices. Average prices are usually derived as a proxy for explicit prices and these average prices result from dividing expenditures by quantities purchased. These average prices, while providing a

critical variable for determining elasticities, do not provide the one-to-one matching suggested by the theory of consumer choice. Consumer choice theory defines a one-to-one relationship between quantity demanded and price (Varian, p. 74). Moreover, the relevant prices and quantities are those purchasers confront at the place and time of purchase. For example, if consumers must choose between a 2-pound box of rice at $2.69 and a 1.5-pound box of pasta at $1.89, then it is these explicit prices that influence purchase decisions, not average price per pound of rice or pasta.

In addition to the problems associated with pricing, demand analysis with NFCS data also may be limited by the incomplete representation of consumer quantity choices. Expenditures and quantities in NFCS data reflect consumers' best recall potential (GAO, p. 13). Some researchers have attempted to convert these recalled quantities to a base which best reflects consumers' preference functions (Gao, et al., 1994). Yet, such measures as derived unit- or dry-weight equivalences for the "quantity demanded" dependent variable may differ widely from those consumers confront at the purchase level.

Consider potatoes as an example of a product whose converted weight may be an inappropriate reflection of its retail weight. Specifically, converting the cooked weight of potatoes to their fresh-weight equivalence may be appropriate for potatoes purchased in random weights from bulk display, but inappropriate for potatoes purchased in fixed weights from pre-packed bags.

The assumption here is that careful inspection of each item (bulk display) can insure good cooking quality, whereas uninspected purchases in pre-packed bags may lead to large quantities of unusable product. This means that any two consumers may have to purchase different quantities of raw potatoes to realize a fixed quantity of cooked potatoes. Additionally, a given consumer may purchase potatoes in both pre-packed bags and random-weight units from bulk display to satisfy both quality and variety preferences. Since quality and variety are indeed relevant attributes, data sets that reflect these choices are likely to provide more meaningful results.

Scanner Data Quality and Study Objectives

As suggested earlier, supermarket scanner data represents a rich data set that overcome many of the problems associated with NFCS data. It is not only relevant for demand analysis, but it is likely to provide an unbiased representation of the preferences of all income and demographic groups within a close proximity of a store's location[1]. Indeed, an objective of this study is to utilize scanner data from supermarkets in two distinctly different income areas to test for demand elasticity differences between income groups and among product classes.

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[1]Earlier studies (see Holdren, p. 118) have reported that 75% of the shoppers at a given supermarket lives within a 1-mile radius of the store. The wider, 5-mile radius of stores used in this study is expected to capture all shoppers for a given store.

Variety and quality differences will be reflected in the model specification to try and capture the relative importance of these factors on consumer purchase decisions.

In short, the primary objective of this study is to estimate own-price, cross-price, and expenditure elasticities for several carbohydrates -- dried potatoes, fresh potatoes, frozen potatoes, pasta and rice. Since consumers, in making purchases, are required to select from different combinations of sizes, brands, and quality dimensions, these attributes will be reflected at the purchase point through a price-weighting scheme. Further, to gain a clearer understanding of the impact and relative importance of these factors for different income groups, stores are selected from both lower- and higher-income areas. Of paramount interest is the question of whether lower- and higher-income consumers show similar or dissimilar purchasing behavior. Additional interests pertain to the questions of (1) whether own-price elasticities for carbohydrates are elastic or inelastic; (2) whether cross-price elasticities reflect substitute or complementary relationships; and (3) whether expenditure elasticities suggest necessary or inferior goods.

The aforementioned carbohydrates are selected for this study because of their strong and growing importance in consumers' diets, their large economic value, and the general interest of the underlying commodity groups (pasta, potato, and rice) in the cross-price relationships among these products. Recent consumption data show rising per capita intake of all

carbohydrates, with rice and pasta showing especially large increases (Childs, 1993; Marketing Intelligence Service, 1994; Wall Street Journal, 1994). Products included in this study had a 1995 estimated retail value of over $7 billion, with fresh potatoes having the highest retail value of roughly $4.3 billion (Supermarket Business, 1995; Potato Facts, 1996). All the carbohydrates included in this study are perceived to be substitutes for each other by their respective commodity groups. Indeed much of the promotional efforts of the represented commodity groups is targeted toward convincing consumers that a product offered by one commodity group is a more desirable side dish with main courses than alternative products offered by competing commodity groups. Estimated cross-price elasticities from this study, of course, are expected to shed some insight on the extent to which consumers view these products as substitutes or complements.

Economic and Socioeconomic Information by Store Location

Given the interest in evaluating differential shopping behavior of lower- and higher-income consumers, the data set for this study is selected from supermarkets in two distinctly different income areas (See Table 1). Specifically, three stores are selected from lower-income areas, and three from higher-income areas. These income areas are identified by using census tract data from the 1990 Census of Population and Housing. Specifically, family income related to a given store represents

the average family income for census tracts within a 5-mile radius of that store's location. Population figures shown in Table 1 reflect the size and configuration of census tracts for each store's location. All the higher-income stores are in suburban areas where the configuration and size of census tracts differ somewhat from those for lower-income stores in central city areas. Regardless of how configured, all the relevant population within a 5-mile radius of a store's location has been captured.

Focusing on just the census-tract data in Table 1, it can be seen that stores 1, 2 and 3 are located in higher-incomes areas and the patrons of these stores have incomes that are roughly 79 percent higher than the incomes of patrons in lower-income stores 4, 5 and 6. Other noticeable differences among the six locations relate to educational levels and poverty rates. Looking across the higher-income locations, it can be seen that an average of 70 percent of the college-age population has obtained a college education. By contrast, an average of just 27 percent of the college-age population in the lower-income locations has obtained a college education. Similar disparities are shown in the levels of poverty. An average of 12 percent of the residents in lower-income areas are below the poverty level, whereas this figure for higher-income areas is just 3 percent. Simply stated, the census-tract data in Table 1 show pronounced differences in income and educational levels between areas, but great similarities in socioeconomic factors within a given area.

Data Description

Data used in this study was obtained from one of the leading supermarket chains in the Columbus, Ohio, metropolitan area. A total of 54 weeks of data is analyzed, covering the last week of 1993 through the first week of 1995. Five product categories are represented in the data set: dried potatoes, fresh potatoes, frozen potatoes, pasta, and rice. Four of these five categories are further separated by brands or product characteristics, yielding a total of 11 different product classes. Frozen potatoes are separated into four product classes: Ore-Ida brands, McCain brands, private label (store) brands, and all other brands. Within the frozen potato category at the national level, Ore-Ida brands are by far the largest, representing more than 54% of total sales (Spethmann, 1993). Private label brands captures about 20% of total sales, McCain about 8%, and all other brands the remaining share (Grimm, 1992; Spethmann, 1993).

Three other products, dried potatoes, pasta, and rice, are segmented into national and private label brands. National brands are dominant in all three product categories, but private label brands capture at least 10 percent of the Columbus market in each product category. Even though pasta is often segmented into dry, frozen and refrigerated categories, the relatively smaller categories of frozen (12.7%) and refrigerated (10.7%) pasta and the overall interest in consumer response to price differences leads to segmentation of pasta by brand identification (Marketing Intelligence Service, 1994). Fresh

potatoes are not branded, and therefore no attempt is made to segment this product.

Focusing on the store-level data in Table 1[2] and that pertaining to potato sales in Table 4, it can be seen that fresh potatoes generate the largest sales and dried potatoes the least sales among the five product categories. Together these five product categories represent less than 2% of total store sales, suggesting that each product category represents a very small part of the consumer's food budget. Average customer purchase, customer count, and sales per square foot are slightly higher for higher-income stores. Differences among the six stores, however, are not so great as to suggest that one group of stores is far more efficient than another.

Model Development and Estimation Procedures

Following the seminal work of Holdren (1960) and an application of Holdren's work to supermarket data by Capps (1989), a multiple product retail demand function is specified for this study. The products of this model are considered to be interdependent, with quantity purchased of any given product being a function of its own-price, prices of related products, store expenditures, and other factors which impact supermarket purchases. Specifically, the model is specified as:

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[2]Fresh potato sales are not included in Table 1 because of concerns about information overload. These sales are therefore shown separately in Table 4.

(1) $Q_{it} = f(P_{it}, P_{jt}'s, HOL, PAY, TEXP_t, GRW_t, Q_{it-1})$,

where Q_{it} is total ounces of product group i in week t (i = 1,...,9, and t = 1,...,54); P_{it} is a weighted-average price of product group i in week t; P_{jt}'s represent weighted-average prices for competing product groups in week t; HOL is a zero-one variable for calendar holidays; PAY is a zero-one variable measuring nearness to payday (PAY = 1 for weeks including the 1st or 15th of each month; 0 otherwise); $TEXP_t$ represents total store expenditures in week t (intended as a proxy for consumer income); GRW_t is a trend variable expressed from 1 to 54, intended to capture growth of the various product sales; and Q_{it-1} is total ounces of product group i purchased during the previous week. Descriptive statistics for prices and expenditures are provided in Tables 2, 3 and 4.

Prices are determined by expressing each product sale as a ratio of all product sales within a given product group. Specifically, weighted price for product group i in each time period is:

(2) $P_i = \sum_j W_{ij}P_{ij}$, where $W_{ij} = (P_{ij}\ Q_{ij}) / (\sum_j P_{ij}\ Q_{ij})$

and j denotes the products in the same group. Because each product group is a potential substitute or complement of other product groups, all product groups are included in each equation. Equation (1) leads to 9 equations to be estimated. (Nine equations, as opposed to 11, are estimable because two products,

private label dried potatoes and private label rice, introduced multicollinearity problems into the data set. These products were therefore aggregated with their respective national brands for estimation purposes). All of the equations have similar independent variables, but contemporaneous correlation is likely to exist among the error terms because of omitted variables and other exogenous factors which are undoubtedly common to all stores and all product classes. This presence of contemporaneous correlation suggests the efficacy of an estimation technique such as seemingly unrelated regression (Pindyck and Rubinfeld, 1981).

Since store-level own-price, cross-price, and expenditure elasticities are empirical measures which can shed considerable insight on consumer behavior, the equations of this study are specified in double logarithmic functional form to give direct measurement of this behavior. Because previous studies have given mixed results about the linkage between consumer incomes and price responsiveness, no a priori hypotheses are advanced regarding expected price or expenditure elasticities for the two different income areas. With respect to breakfast cereals, Jones and Mustiful (1996) found lower-income consumers to be considerably more price responsive than higher-income consumers. Park and others (1996) found lower- and higher-income consumers to exhibit the same degree of price responsiveness for breakfast cereals and many other products, including milk, bread, beef and pork. Given these varying results, no hypotheses are offered regarding price response behaviors of lower- and higher-income

consumers. However, own-price elasticities are expected to be negative and statistically significant, expenditure elasticities are expected to reflect normal goods, and, based on the findings of Gao and others (1994), cross-price elasticities may be hypothesized to show substitute relationships.

Empirical Results

Results reported in this paper will focus on own-price, cross-price and expenditure elasticities. Only a general summary is provided of other variables, because these other results can serve as a distraction to the primary focus of this paper. In general, all equations, with private label frozen potatoes being an exception, were statistically significant as measured by the F-value in the first stage (OLS) regression. Weighted R-squares for the system of equations across all stores ranged from 62.0 to 72.2. Holidays and paydays had no statistically significant impact on the purchase of any of the products on a consistent basis. Further, the lagged dependent variable in each equation, intended to capture habit persistence, proved to be statistically insignificant for most products across all stores. Also, parameter estimates for the growth variable tended to be statistically insignificant and therefore showing no consistent pattern of change for any of the product classes. These observations may simply reflect the fact that consumer expenditures and product prices are reasonably low for all of the included product classes.

Looking across all products and all stores (Tables 5 and 6), it can be seen that most own-price elasticities are elastic and statistically significant, save for two product categories, rice and private-label frozen potatoes. None of the own-price elasticities for these two products are statistically significant. Yet, positive and statistically significant expenditure elasticities for these two products suggest that these are not inferior products. Taken together, these price and expenditure elasticities suggest that consumers have a strong preference for these products and this preference simply is not influenced by the range of price changes over the observed data period. Further, since a calculation of the coefficient of price variation for all product classes showed even higher price variations for these two product classes than for many of the other product classes with statistically significant own-price parameters, it seems reasonable to conclude that these product prices were just too low to have a significant impact on purchase decisions. Further, price insensitivity to rice may be due to the growing popularity of rice in Americans' diets. Per capita data show rice consumption to be increasing faster than that of pasta and potatoes (Marketing Intelligence Service, 1994) and these data also show rice consumption to have tripled over the past 20 years (Prepared Foods, 1993; Liesse, 1994).

Despite the statistical insignificance of the own-price elasticities for rice and private label frozen potatoes, all expenditure elasticities for rice and half of those for potatoes

(all three lower-income stores) are significant. These measures suggest that consumers view these products as normal goods and they purchase them irrespective of price changes. Further, private label frozen potatoes are shown to be a substitute for Ore-Ida potatoes in all stores (Table 6), but an even stronger substitute in lower-income stores[3]. Rice, by contrast, is shown to be neither a substitute nor a complement with any of the products on a consistent basis. Also, the purchase patterns for private label frozen potatoes and private label rice suggest that lower-income consumers are more sensitive to overall product prices, but these sensitivity levels are not reflected in the magnitude of elasticities. Indeed with all the own-price elasticities being statistically insignificant, it seems reasonable to conclude that these products are a small enough proportion of the consumer' total budget that price changes are not noticeable.

Own-price elasticities for the three remaining product classes of frozen potatoes are generally elastic with no consistent differences in magnitude by income groups. Ore-Ida brands of potatoes yield four own-price elasticities close to unitary, and two others which are more elastic. These more elastic measures are for higher-income stores 2 and 3. Comparing differences in purchase percentages of Ore-Ida potatoes by income

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[3]Cross-price elasticities are shown for just four products: private label frozen potatoes, Ore-Ida potatoes, private label pasta, and national brands of pasta. These are the only four products with consistent patterns of substitute or complementary relationships.

groups (Table 2), higher-income groups are shown to purchase much larger percentages (54.7% vs 39.8%). Such percentage differences suggest that price changes for certain commodities have little impact on purchased quantities once consumers develop an optimal combination in their overall market basket. That is, even though consumers do not greatly alter their market basket of purchases, they are still maximizing utility according to a well-ordered preference function. The more than 2 to 1 Ore-Ida to private label purchase ratio (quantity ratio in Table 2) for higher income stores, as compared to the near 1 to 1 ratio for lower-income stores, suggests major differences between the two income groups in the market basket mix. However, own-price elasticity differences between the two groups suggest that their is likely to be little deviation from these optimal mixes in response to price changes.

Own-price elasticities for McCain potatoes are statistically insignificant for three stores, inelastic for two, and just slightly above unitary elasticity for another (Table 5). This product class was isolated because the company is a relatively new player in the Columbus market and it uses a fair amount of price promotion to try and cultivate a customer base. The relatively low own-price elasticities are likely to reflect the inconsequential share of the product in consumers' budgets. Further, consumers did not express any strong preference for the product as just one expenditure elasticity is statistically significant. With the product cost being closer to that of

private label frozen potatoes than to that of Ore-Ida brands, market shares and the elasticity measures suggest that consumers have not yet made it a permanent part of their market basket mix.

Other brands of frozen potatoes have very elastic own-price elasticities and these magnitudes are most likely due to the nature of the product. These are mainly french fries for microwave ovens and they are considered to be rich in convenience attributes. With all the expenditure elasticities for this product class being statistically significant, this suggests that consumers do have a strong preference for these convenience attributes. Relative to purchased quantities, higher-income consumers expressed a much stronger preference for the product (Table 2). This preference, of course, is consistent with that expressed for the higher-priced Ore-Ida brands. Looking across the cost paid per ounce for all the frozen potatoes, it can be seen that lower-income shoppers purchased the lowest-price products within each of the product classes (Table 3). These purchase patterns suggest greater price sensitivity, even though this behavior is not obvious from differences in the elasticity measures. And while these elasticities do not contradict those reported by Park and others (1996), they reveal considerably more insight into consumer shopping behavior. Product selections clearly indicate more price sensitivity for lower-income shoppers. Undoubtedly, price variations over the data period have not been dramatic enough to generate statistical differences in elasticity measures.

All own-price elasticities for dried potatoes are elastic and statistically significant. Further, all but one of the expenditure elasticities for dried potatoes are positive and significant. On the basis of the elasticity parameters, lower-income consumers are shown to be slightly more price sensitive than higher-income ones. This greater sensitivity is further supported by the purchasing patterns for the private label and national brands of dried potatoes. Lower-income consumers purchase a much higher percentage (15.1% vs 9.9%) of the lower-priced private label dried potatoes. Further, prices paid per ounce of purchase show lower-income shoppers to purchase the lowest-priced products even within the national brands of dried potatoes. In essence, lower- income shoppers maximize their utility by selecting a market basket of goods to minimize their total grocery expenditures.

Despite the statistical significance of all the own-price elasticities for dried potatoes, cross-price elasticities do not show the product to be consistent substitutes or complements for any of the other carbohydrates. For two of the higher-income stores, these products are substitutes for private label pasta, and in four of the stores they are complements with fresh potatoes. This latter observation suggests that consumers do not view pasta and potatoes as substitute at the purchase level, even though they might view them as such at the consumption level.

Own-, cross-, and expenditure elasticities for private label pasta are somewhat mixed, but consistent with the overall pattern

for other products included in this study. All of the own-price elasticities are statistically significant, but three are inelastic and three are elastic. These varying magnitudes are likely to reflect the relatively low price of the product as well as its relatively large share of the total pasta category (over 22% in quantity). Expenditure elasticities for this product class are statistically significant in four of the six stores and these measures suggest that consumers have a favorable assessment of the overall quality of private label pasta. Further, all the cross-price elasticities show private label pasta to be a substitute for national brands.

As compared to cross-price elasticities for some of the other product classes, the consistent substitute relationship of private label pasta for branded pasta suggests that consumers look more within product categories than across product categories when making purchase decisions about lower-priced products (Table 6). This observation holds across income levels, as the magnitude of the cross-price elasticities offer no basis to suggest that private-label pasta is a stronger substitute for national brands in lower-income stores. Yet, it should be noted that lower-income shoppers purchase a much larger percentage of the lower-priced private-label brands (27% vs 22%). Again, these differences in purchasing behavior would suggest that consumers attempt to maximize their utility by selecting a market basket of goods to minimize their total grocery expenditures.

Just as consumers find private-label pasta to be a

reasonable substitute for national brands of pasta, a large number of them (shoppers in 4 of 6 stores) also find national brands to be a substitute for private label brands. This weaker two-way substitution pattern is further supported by the higher degree of demand elasticity for national brands of pasta. Since the number and quality of substitutes influence the magnitude of own-price elasticities, the relatively larger elasticities for national brands of pasta would suggest that consumers find more and/or better substitutes for national brands than for private-label brands of pasta. Differences in these substitution patterns also are consistent with the fact that consumers are more likely to substitute a lower-priced product for a higher-priced one. Despite the higher price of national brands of pasta, the expenditure elasticities for all but one of the stores suggest that consumers increase their consumption of the brands as their income increases (Table 6).

The final product class, fresh potatoes, reveals statistically significant and mostly elastic own-price elasticities. The empirical values for this product class are possibly not as meaningful as those for other product classes because quantities sold reflect warehouse-to-store shipments, not store-to-consumer sales. Looking across the coefficient of quantity variations for warehouse-to-store shipments, it is revealed that the more orderly the purchase process, the lower the own-price elasticities. For example, stores 1 and 2 had the most orderly purchase process (ordering a fairly uniform quantity

each week) and these stores are shown to have inelastic demands. Elastic demands are revealed for all remaining stores and the magnitude of these parameters varies with the size of the coefficient of variations. Since store size would not suggest a storage constraint for store 1, it is hypothesized that stores 1 and 2 have most likely implemented a computerized purchasing process for fresh potatoes. This orderly purchase process of warehouse-to-store shipments, as opposed to store-to-consumer sales, may partly account for the statistical insignificance of the expenditure elasticities.

Even though warehouse-to-store shipments seem to have influenced elasticity measures for this product class, it should be emphasized that parameter estimates for the other product classes remained largely unchanged when this product class was excluded from the model. Relative to the substitute relationships that commodity groups perceive to exist among potatoes, rice and pasta, results derived in this study do show fresh potatoes to be a substitute for branded pasta for most shoppers (save for shoppers in 2 of the lower-income stores). Comparing prices paid per pound for the two income groups, it is quite apparent that lower-income shoppers purchase a larger percentage of the lower-priced, pre-packed bags of potatoes (Table 4). Again, this would suggest that lower-income consumers are more price sensitive than higher-income ones.

Summary and Conclusions

Results from this study show quite clearly that lower-income consumers are more price sensitive than are higher-income ones. This greater price sensitivity is shown most readily by differentials in purchase percentages among product classes. When product classes are segmented by private label and national brands, lower-income shoppers are shown to purchase far larger percentages from the lower-priced private label product classes and they also purchase the least expensive products from higher-priced branded classes. Yet, these purchasing differentials are not reflected in the magnitude of price-elasticity parameters. This lack of divergence is due either to insufficient variation in product prices over the defined data period, or to relatively low levels of total consumer expenditures on the respective products.

Cross-price elasticities showed consistent patterns of substitutability for just four product classes: private label frozen potatoes, Ore-Ida frozen potatoes, private label pasta, and national brands of pasta. These results seem to suggest that consumers purchase a combination of all the low-priced products included in this study and they are most likely to make purchase substitution among closely related brands. For example, if the relative price of national brands to private labels pasta is quite high, consumers are shown to substitute the lower-priced products for the higher-priced one. Likewise, a decline in the relative price ratio of national brands to private label pasta

leads consumers to substitute national brands for private labels. This observed pattern of limited substitution among carbohydrates is in sharp contrast to the general pattern of substitution reported among these products by researchers who have utilized NFCS data. A conclusion offered here is that NFCS data sacrifice product details (brands, explicit product prices, etc.) which lead to distorted elasticity measures. Indeed a reasonable conclusion is that the product details which have been sacrificed have constrained consumer choices to the point of yielding inelastic own-price elasticities when if fact these coefficients are elastic.

An important distinction between the elasticities reported in studies using NFCS data and those reported here is that these elasticities are calculated at the level in which consumers make purchase decisions. Studies utilizing NFCS data are reporting elasticities based on consumers' actual consumption decisions. For such results, implicit product prices serve as a proxy for the more appropriate and relevant explicit product prices. Another important distinction between this study and those using NFCS data is that this study uses explicit quantities, whereas studies using NFCS data use implicit quantities that reflect consumers' best recall of cooked quantities. In the absence of information to refute the theoretical linkage between consumer decision-making and explicit prices and quantities, it seems more appropriate to rely on data that reflects these measurements.

Table 1. Economic and Socioeconomic Characteristics of Selected Supermarkets.

Store Location	Census-Tract Data: Population	Median Family Income	Median Age	Population below 25 (Percent)	Population ≥ 25 yrs. w/o College Ed. (Percent)	Population below Poverty Level (Percent)	Weekly Store-Level Data: Average Store Sales	Average Frozen Potato Sales	Average Dried Potato Sales	Average Rice Sales	Average Pasta Sales	Average Customer Count	Average Customer Purchase	Average Sales Per Square Feet
Higher Income														
Store 1	20,567	$63,238	38.7	28.7	17.9	2.4	$606,197	$1,122	$452	$1,633	$2,603	25,318	$23.94	$9.92
Store 2	23,031	$44,051	31.3	34.6	39.3	3.0	$352,117	$ 879	$342	$ 630	$1,143	16,660	$21.13	$8.36
Store 3	44,333	$48,488	31.6	37.9	34.4	3.4	$514,807	$1,489	$520	$1,036	$1,937	24,118	$21.34	$9.17
Avg.	29,310	$51,926	33.9	33.7	30.5	2.9	$491,040	$1,163	$438	$1,099	$1,894	22,032	$22.14	$9.15
Lower Income														
Store 4	13,913	$32,305	28.9	35.9	80.8	9.2	$484,630	$1,605	$843	$ 868	$1,702	20,034	$24.19	$8.81
Store 5	15,492	$26,609	33.1	39.5	64.6	17.7	$381,954	$1,111	$499	$ 863	$1,237	22,881	$16.69	$9.07
Store 6	12,636	$27,844	32.4	33.7	74.4	10.4	$448,445	$1,324	$733	$ 738	$1,501	21,092	$21.26	$7.61
Avg.	14,014	$28,919	31.5	36.4	73.3	12.4	$438,343	$1,347	$692	$ 856	$1,480	21,336	$20.71	$8.50

Sources: Bureau of the Census, 1990 Census of Population and Housing: Census Tracts Data on CD-Rom. Columbus, Ohio Standard Metropolitan Statistical Area, U.S. Department of Commerce, July, 1992; an A National Supermarket Chain Store.

Table 2. Descriptive Statistics of Category Quantities, Percentages, and Prices.

	Higher Income Stores			Average	Lower Income Stores			Average
	Store 1	Store 2	Store 3	Higher Income	Store 4	Store 5	Store 6	Lower Income
Category Quantities-Ounces[a]								
Frozen Potatoes	3192	3506	5546	4081	8538	9723	9285	9182
Private Label	8268	6720	11440	8809	8981	10561	7037	8859
Ore-Ida	766	975	1709	1150	1349	2953	1496	1932
McCain	2219	1356	2261	1945	2151	2439	1486	2025
Other Products								
Dried Potatoes	177	194	347	239	574	815	441	610
Private Label	2372	1775	2605	2250	3801	4335	2601	3582
National Brands								
Rice	5418	1872	3164	3484	2344	2829	5175	3449
Private Label	9712	3736	6280	6576	4213	4950	4820	4661
National Brands								
Pasta	7933	4191	6740	6288	6029	8095	6114	6746
Private Label	31679	14800	23632	23370	18968	20647	15933	18516
National Brands								
Category Quantities-Percents[b]								
Frozen Potatoes	22.21	28.32	26.59	25.71	40.83	38.02	48.32	42.39
Private Label	57.14	52.60	54.34	54.69	42.48	40.87	36.21	39.85
Ore-Ida	5.31	8.17	8.23	7.24	6.43	11.56	7.78	8.59
McCain	15.34	10.91	10.84	12.36	10.26	9.55	7.69	9.17
Other Products								
Dried Potatoes	7.21	10.44	12.31	9.99	13.82	16.30	15.18	15.10
Private Label	92.79	89.56	87.69	90.01	86.18	83.70	84.82	84.90
National Brands								
Rice	35.93	33.28	33.42	34.21	35.75	36.24	51.44	41.14
Private Label	64.07	66.72	66.58	65.79	64.25	63.76	49.56	59.19
National Brands								
Pasta	20.23	22.72	22.59	21.85	24.39	28.53	28.06	26.99
Private Label	79.77	77.28	77.41	78.15	75.61	71.47	71.94	73.01
National Brands								
Category Prices-Dollars[c]								
Frozen Potatoes	1.62	1.69	1.69	1.67	1.82	1.91	1.93	1.89
Private Label	2.13	2.23	2.18	2.18	2.35	2.41	2.48	2.41
Ore-Ida	2.10	2.11	2.08	2.09	2.16	2.19	2.16	2.17
McCain	1.75	1.66	1.68	1.70	1.63	1.59	1.63	1.62
Other Products								
Dried Potatoes	1.75	1.75	1.82	1.77	1.91	2.13	1.82	1.95
Private Label	1.76	1.70	1.77	1.74	1.78	1.68	1.74	1.73
National Brands								
Rice	1.89	1.69	1.75	1.78	1.59	1.57	1.67	1.61
Private Label	1.68	1.56	1.60	1.61	1.49	1.44	1.57	1.50
National Brands								
Pasta	1.00	.97	1.00	.99	.98	.95	.97	.97
Private Label	1.29	1.26	1.28	1.27	1.24	1.24	1.26	1.25
National Brands								

[a]Ounces sold per week; [b]Quantity share of product within its product category; [c]Average product price per package sold.

Table 3. Descriptive Statistics of Category Sales, Percentages, and Unit Costs.

	Higher Income Stores			Average	Lower Income Stores			Average
	Store 1	Store 2	Store 3	Higher Income	Store 4	Store 5	Store 6	Lower Income
Category Sales-Dollars[a]								
Frozen Potatoes								
Private Label	148	162	264	191	376	438	402	405
Ore-Ida	664	510	876	683	659	754	488	634
McCain	44	55	98	66	76	166	84	109
Other Products	264	151	250	222	211	245	135	197
Dried Potatoes								
Private Label	26	28	51	35	83	112	65	87
National Brands	425	313	469	402	649	730	432	604
Rice								
Private Label	187	66	116	123	90	110	161	120
National Brands	1445	563	919	976	647	758	700	702
Pasta								
Private Label	394	197	321	304	282	375	291	316
National Brands	2208	946	1615	1590	1216	1326	955	1166
Category Sales-Percents[b]								
Frozen Potatoes								
Private Label	13.31	18.62	17.81	16.58	28.56	27.36	36.44	30.79
Ore-Ida	59.34	57.52	58.75	58.54	49.76	46.87	43.76	46.80
McCain	3.95	6.61	6.59	5.72	5.72	10.42	7.59	7.91
Other Products	23.39	17.24	16.83	19.15	15.97	15.34	12.21	14.51
Dried Potatoes								
Private Label	5.98	8.74	10.21	8.31	11.76	13.68	13.67	13.04
National Brands	94.02	91.25	89.79	91.69	88.24	86.32	86.33	86.96
Rice								
Private Label	11.57	10.61	11.32	11.17	12.34	12.72	19.11	14.72
National Brands	88.43	89.38	88.68	88.83	87.66	87.28	80.89	85.28
Pasta								
Private Label	15.26	17.53	16.68	16.49	18.85	22.14	22.88	21.29
National Brands	84.74	82.47	83.32	83.51	81.15	77.86	77.12	78.71
Category Costs-Cents[c]								
Frozen Potatoes								
Private Label	4.67	4.63	4.77	4.69	4.42	4.51	4.34	4.42
Ore-Ida	8.11	7.74	7.75	7.87	7.44	7.26	7.04	7.25
McCain	5.90	5.82	5.84	5.85	5.76	5.78	5.76	5.77
Other Products	12.03	11.20	11.58	11.60	9.97	10.33	9.48	9.93
Dried Potatoes								
Private Label	15.13	15.03	14.95	15.04	14.66	14.17	14.99	14.61
National Brands	18.26	18.01	18.29	18.19	17.45	17.16	16.79	17.13
Rice								
Private Label	3.48	3.59	3.72	3.60	3.89	3.94	3.16	3.66
National Brands	14.93	15.14	14.66	14.91	15.40	15.38	14.21	15.00
Pasta								
Private Label	4.99	4.76	4.81	4.85	4.70	4.68	4.63	4.67
National Brands	7.02	6.53	6.95	6.83	6.51	6.54	6.10	6.38

[a]Dollar sales per week; [b]Dollar share of product within its product category; [c]Cost of product in cents per ounce.

Table 4. Descriptive Statistics for Fresh Potatoes

	Higher Income Stores			Average	Lower Income Stores			Average
	Store 1	Store 2	Store 3	Higher Income	Store 4	Store 5	Store 6	Lower Income
Category Quantities-Pounds[a]								
Fresh Potatoes	9058	4840	7259	7052	12782	8703	9856	10447
Category Prices-Dollars[b]								
Fresh Potatoes	.57	.45	.44	.49	.32	.32	.35	.33
Category Sales-Dollars[c]								
Fresh Potatoes	3442	1529	2279	2417	3157	2229	2534	2640
Category Costs-Cents[d]								
Fresh Potatoes	39.42	33.31	33.72	35.48	26.86	28.55	28.29	27.90

[a] Pounds sold per week; [b] Weighted price per pound; [c] Dollar sales per week; [d] Cost of product in cents per pound.

Table 5. Relative Comparisons of Own-Price Elasticities
(T-ratios are in parenthesis)

	Store 1	Store 2	Store 3	Store 4	Store 5	Store 6
Frozen Potatoes						
Private Label	.71 (-1.41)	.26 (.68)	-.19 (-.47)	-.14 (-.38)	-.29 (-.65)	-.24 (-.57)
Ore-Ida	-.98 (-3.00)	-1.48 (-3.50)	-1.33 (-3.86)	-1.06 (-2.33)	-1.04 (-1.94)	-1.07 (-2.18)
McCain	-.28 (-.39)	-.97 (-2.25)	-1.09 (-2.69)	-.79 (-1.98)	.07 (.21)	-.33 (-.87)
Other Brands	-1.96 (-1.74)	-1.43 (-2.83)	-3.14 (-4.71)	-2.00 (3.58)	-2.56 (-3.69)	-1.71 (-2.17)
Rice	-.94 (-1.03)	.80 (1.32)	-.05 (-.18)	-.49 (-.81)	.29 (.72)	-.20 (-.33)
Dried Potatoes	-1.63 (-2.58)	-1.30 (-2.32)	-1.18 (-1.92)	-2.43 (-4.80)	-1.61 (-2.34)	-1.77 (-3.00)
Pasta						
Private Label	-1.43 (-1.70)	-1.69 (-4.36)	-1.86 (-5.44)	-1.08 (-3.69)	-.89 (-3.03)	-.80 (-1.94)
National Brands	-1.86 (-3.48)	-3.01 (-6.03)	-2.31 (-4.43)	-1.64 (-4.74)	-1.97 (-5.42)	-1.25 (-2.97)
Fresh Potatoes	-.36 (-1.68)	-.41 (-1.73)	-2.11 (-6.52)	-1.58 (-5.11)	-2.15 (-6.05)	-1.26 (-5.54)

Table 6. Expenditure Elasticities and Selected Cross-Price Elasticities
(T-ratios are in parenthesis)

	Store 1	Store 2	Store 3	Store 4	Store 5	Store 6
Frozen Potatoes			Expenditure Elasticities			
Private Label	.62 (.97)	1.13 (1.54)	-.21 (-.28)	1.09 (2.61)	1.58 (3.68)	1.27 (2.35)
Ore-Ida	1.66 (3.49)	.46 (1.84)	.39 (2.29)	.81 (1.95)	1.63 (2.75)	1.84 (3.78)
McCain	-.89 (-.04)	.46 (.32)	1.44 (1.33)	.45 (.68)	1.75 (2.69)	.01 (.03)
Other Brands	1.85 (2.98)	3.17 (3.89)	3.08 (2.74)	.98 (1.95)	1.81 (2.36)	3.07 (5.48)
Rice	.62 (1.79)	.56 (1.82)	2.03 (5.48)	.85 (2.27)	1.86 (6.18)	1.98 (3.81)
Dried Potatoes	1.69 (1.98)	1.36 (1.72)	1.28 (1.70)	1.73 (3.64)	2.65 (6.46)	1.85 (2.04)
Pasta						
Private Label	.01 (.02)	.40 (.53)	1.98 (2.84)	1.40 (1.73)	1.41 (4.69)	1.98 (4.38)
National Brands	.48 (2.18)	1.38 (2.12)	.40 (.67)	.56 (1.72)	1.59 (4.79)	1.28 (3.15)
Fresh Potatoes	1.37 (1.90)	1.48 (1.48)	1.66 (1.08)	.82 (.98)	.87 (1.15)	.90 (.99)
			Cross-Price Elasticities			
Pasta						
Private Label for National Brands	1.46 (2.00)	.91 (1.77)	1.74 (2.81)	1.61 (3.52)	1.09 (3.25)	2.02 (4.36)
National Brands for Private Label	.32 (1.53)	.73 (2.34)	.52 (1.83)	.28 (1.31)	.84 (2.66)	.66 (1.86)
Frozen Potatoes						
Private Label for Ore-Ida Brands	.74 (1.69)	.78 (1.96)	1.18 (2.67)	1.62 (4.39)	.67 (1.85)	.52 (1.75)
Ore-Ida Brands for Private Label	.27 (.75)	.21 (.53)	-.31 (-.96)	-.14 (-.31)	.24 (.39)	.13 (.33)

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